EPA/ROD/R03-01/031
2001

EPA Superfund
Record of Decision:

MARINE CORPS COMBAT DEVELOPMENT COMMAND
EPA ID: VA1170024722
OU 01
QUANTICO, VA
10/13/2000

SITE 1 - PESTICIDE BURIAL AREA

MARINE CORPS COMBAT DEVELOPMENT COMMAND (MCCDC) QUANTICO, VIRGINIA

RECORD OF DECISION

OCTOBER 2000

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1.0 THE DECLARATION

1.1 SITE NAME AND LOCATION

Marine Corps Combat Development Command
Quantico, Virginia
CERCLIS ID # VA1170024722
Pesticide Burial Area OU-1

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedial Action for Site 1 - Pesticide Burial Area at the Marine Corps Combat Development Command (MCCDC) Quantico, Virginia. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for Site 1.

The Commonwealth of Virginia concurs with the selected remedy.

1.3 DESCRIPTION OF THE SELECTED REMEDY

No further CERCLA action is necessary for Site 1 to protect public health, or welfare, or the environment, although further confirmatory monitoring will be performed to confirm that no unacceptable current/future risks are posed by exposures to pesticides in groundwater at the operable unit. Because of a single detection of dieldrin from a temporary well (PBATW003) in October 1997, a temporary monitoring well will be installed downgradient of PBATW003 and the groundwater sampled for this pesticide. The result of the analysis will be compared to the USEPA Region III Risk-Based Screening Level for dieldrin in Residential Tap Water (4.2 mg/L). If the analytical result of the groundwater sampling is less than the respective screening level, the site will close with No Further Action. If the analytical result is determined to be higher than the screening level, a second round of sampling will be conducted and the Navy and regulators will re-evaluate the site.

1.4 DECLARATION STATEMENT REGARDING STATUTORY DETERMINATIONS

The Selected Remedy (No Further Action with confirmatory monitoring) for Site 1 is protective of human health and the environment because previous removal activities at this operable unit have eliminated the

existing and potential risks to human health and the environment. Post-removal sampling indicates that Site 1 no longer presents an unacceptable risk.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a 5-year review will not be required for this remedial action. However, the groundwater will be sampled and analyzed in order to ensure that dieldrin levels in the groundwater do not pose an unacceptable risk to human health or the environment in the future.

1.5 AUTHORIZING SIGNATURES

The U.S. Navy and the USEPA selected this remedy with the concurrence of the Commonwealth of Virginia Department of Environmental Quality.

Concur and recommended for immediate implementation:

J. F. Cronin
Major General
U.S. Marine Corps Reserve
Commanding General, Marine Corps Base

5 OCT 00
Date

Abraham Ferdas, Director
Hazardous Site Cleanup Division
USEPA - Region III

10/13/00
Date

2.0 DECISION SUMMARY

2.1 SITE 1 - NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) describes the Department of the Navy's (Navy) and EPA's selected remedial action for Site 1 − Pesticide Burial Area at the MCCDC in Quantico, Virginia (Figures 2-1 and 2-2). Site 1 is one of the Installation Restoration (IR) sites (Figure 2-3) located at the MCCDC facility. The National Superfund database identification number for this site is CERCLIS ID # VA1170024722. The Navy serves as the lead agency with Environmental Restoration, Navy Funding (ER, N) serving as the source of funding.

The Pesticide Burial Area consists of a pit located approximately 250 feet northwest of Building 27007 near the intersection of Russell Road and MCB-1. The site is situated on a slope at the edge of a wooded area and adjacent to a parking lot (Figure 2-4). The size of the pesticide burial pit, which received pesticides from the Pest Control Shop (Building 668) in 1974, was reportedly 16 feet in diameter and 8 feet deep.

Several ancillary Installation Restoration Program (IRP) sites are located adjacent to the Pesticide Burial Area and were evaluated with the Pesticide Burial Area. These sites include the Building 2427 Burn Area (L-17), Building 2427 Disposal Area (L-18), Building 27135 Drum Disposal Area (M-29), and an unnamed ancillary IRP site. Due to the proximity of these sites to the Pesticide Burial Area, they were evaluated in the Site 1 RI.

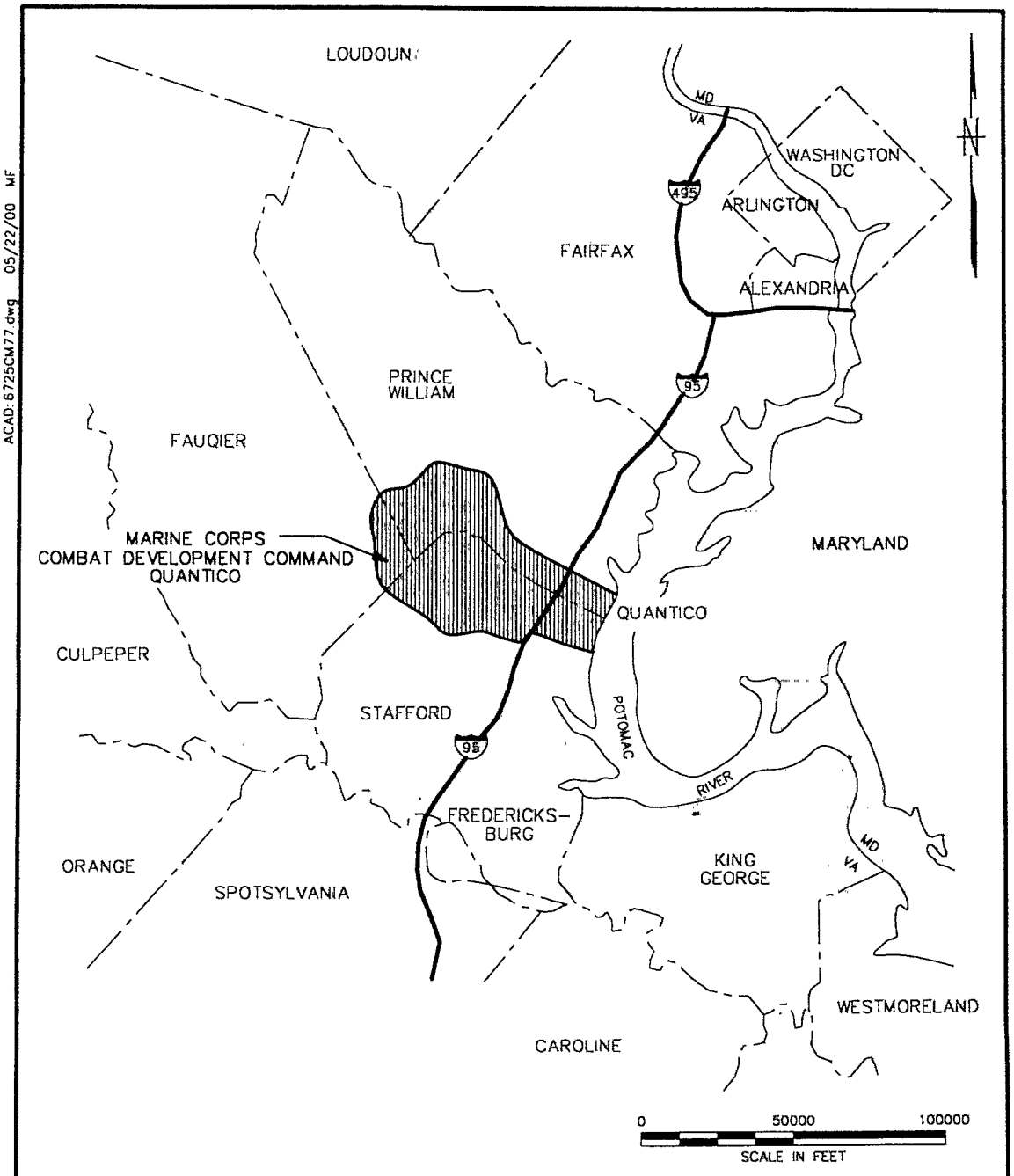
2.2 SITE 1 - HISTORY AND ENFORCEMENT HISTORY

2.2.1 History of Site Activities

The soil was excavated in the Pesticide Burial Area in June 1974 to create a pit for a one-time disposal of waste pesticides. The pesticides that were disposed included lead arsenate, sulfer flour, dieldrin, paris green (cupric acetoarsenite), captan, and kelthane. Dieldrin and kelthane were in liquid, oil-base form and packaged in metal cans. The total volume of dieldrin disposed was approximately 50 liters and the total volume of kelthane was 228 liters. The remaining pesticides were in solid form with a combined weight of 122 kilograms.

2.2.2 Previous Investigations and Removal Actions

Investigations of the Pesticide Burial Area were performed from 1984 to 1998, including the Initial Assessment Study (IAS), confirmation study, and Remedial Investigation (RI). In 1993 Halliburton NUS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495
ARLINGTON
FAIRFAX
ALEXANDRIA
PRINCE WILLIAM
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FAUQIER
MARINE CORPS COMBAT DEVELOPMENT COMMAND QUANTICO
MARYLAND
QUANTICO
CULPEPER
STAFFORD
POTOMAC
RIVER
FREDERICKS-BURG
ORANGE
SPOTSYLVANIA
KING GEORGE
WESTMORELAND
CAROLINE
0
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SCALE IN FEET
DRAWN BY HJP DATE 5/19/00
Tetra Tech NUS, Inc.
CONTRACT NO. 6725
OWNER NO. 0215
CHECKED BY KMS DATE 6/5/00
APPROVED BY Kelly McSweeney DATE 6/15/00
COST/SCHED-AREA
APPROVED BY DATE
VICINITY MAP
MCCDC QUANTICO, VIRGINIA
SCALE AS NOTED
DRAWING NO. FIGURE 2-1
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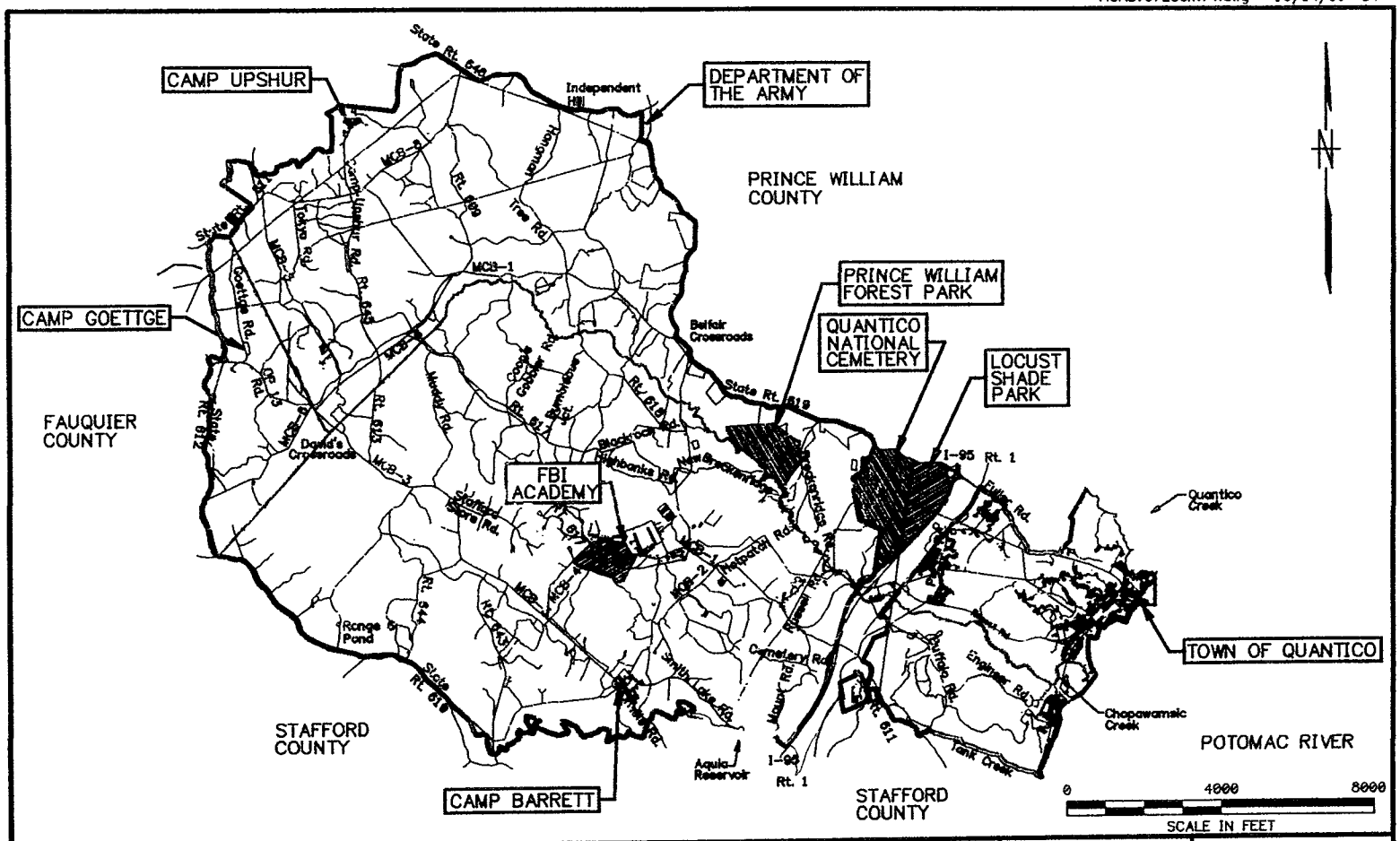

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COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 2-2	REV. 0

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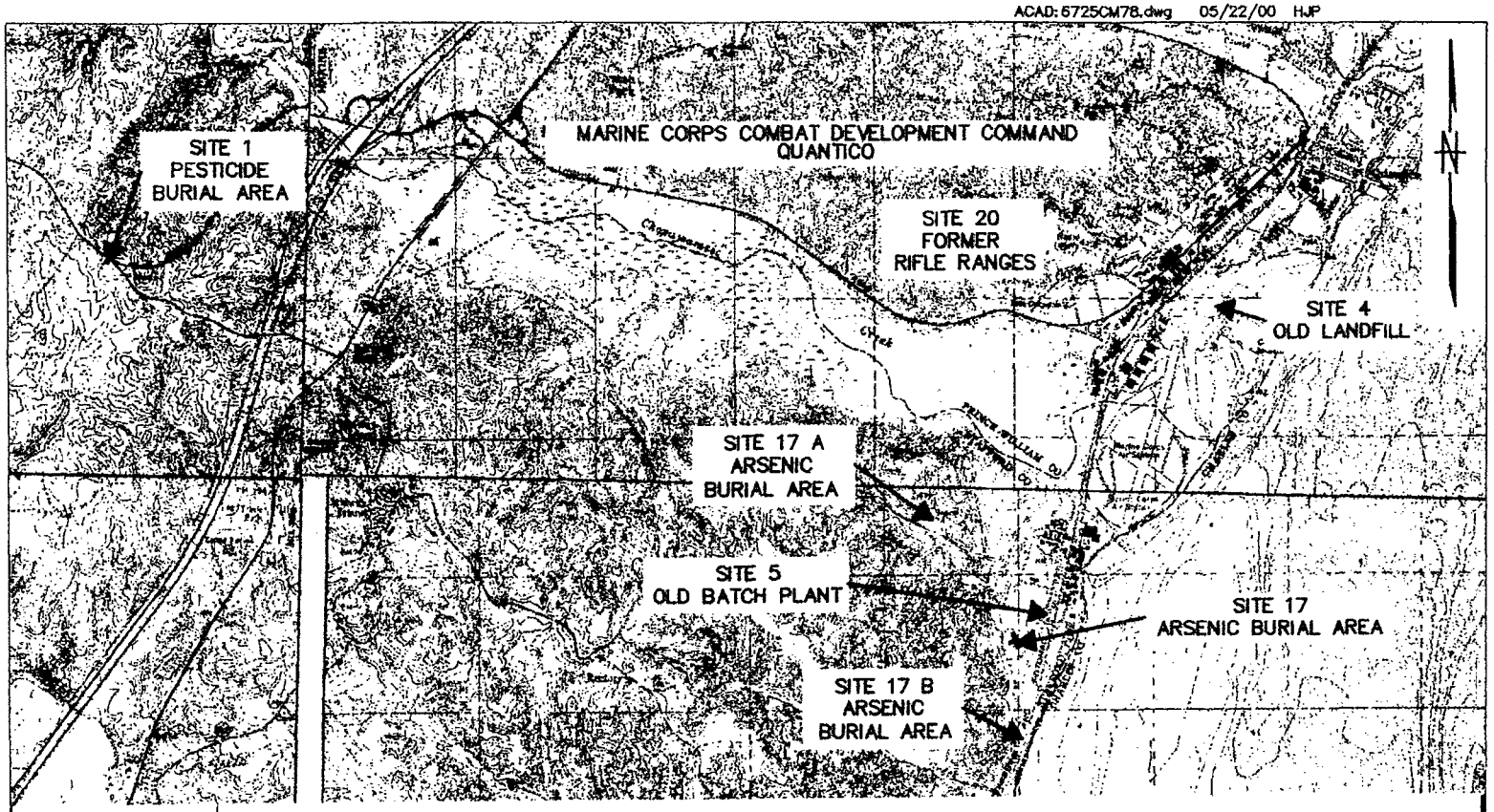
ACAD: 6725CM78.dwg 05/22/00 HJP
SITE 1
PESTICIDE
BURIAL AREA
MARINE CORPS COMBAT DEVELOPMENT COMMAND
QUANTICO
SITE 20
FORMER
RIFLE RANGES
SITE 4
OLD LANDFILL
SITE 17 A
ARSENIC
BURIAL AREA
SITE 5
OLD BATCH PLANT
SITE 17
ARSENIC BURIAL AREA
SITE 17 B
ARSENIC
BURIAL AREA
N
VIRGINIA
QUADRANGLE LOCATION
SOURCE: U.S.G.S QUANDRANGEL MAP OF WHITEWATER,VA.–MD. PHOTOREVISED 1978
BATHYMETRY ADDED 1982; STAFFORD, VA 1966, PHOTOREVISED 1983; QUANTICO, VA.–MD.
1966, PHOTOREVISED 1983, BATHYMETRY ADDED 1982; JOPLIN, VA, PHOTOINSPECTED 1981,
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COST/SCHED–AREA
SCALE AS NOTED
Tetra Tech NUS, Inc.
IR SITE LOCATION MAP
MCCDC QUANTICO, VIRGINIA
CONTRACT NO. 6725
OWNER NO. 0215
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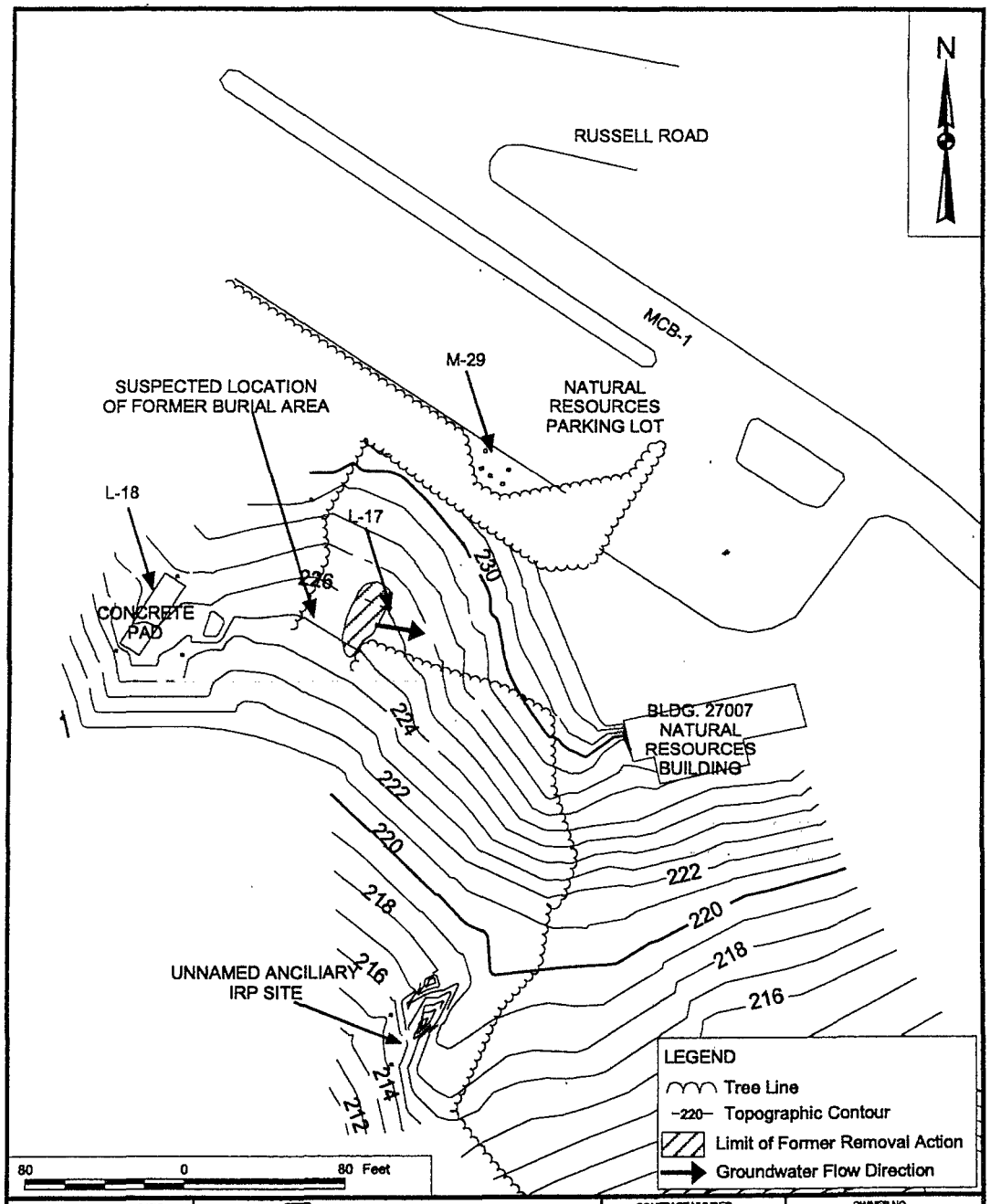

N
RUSSELL ROAD
MCB-1
M-29
SUSPECTED LOCATION
OF FORMER BURIAL AREA
NATURAL
RESOURCES
PARKING LOT
L-18
L-17
226
230
CONCRETE
PAD
224
222
220
218
216
214
212
BLDG. 27007
NATURAL
RESOURCES
BUILDING
UNNAMED ANCILIARY
IRP SITE
LEGEND
Tree Line
220 Topographic Contour
Limit of Former Removal Action
Groundwater Flow Direction
80 0 80 Feet
DRAWN BY J. BELLONE DATE 15-SEP-99
CHECKED BY KMS DATE 10/13/99
COST/SCHEDULE-AREA
SCALE AS NOTED
Tetra Tech NUS, Inc.
SITE LAYOUT
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA
CONTRACT NUMBER 6725
OWNER NO. 0215
APPROVED BY Kelly M Gray DATE 10/13/99
APPROVED BY DATE
DRAWING NO. FIGURE 2-4
REV 0
D:\GIS\QUANTICO\6725_0701_0702.APR 10/13/99 JCB SITE 01 - PESTICIDE BURIAL AREA A LAYOUT

Corporation performed an Engineering Evaluation/Cost Analysis (EE/CA). A source soil removal action was performed in 1994 by Rollins Environmental Site Services, Incorporated, under subcontract to Halliburton NUS Corporation. During this action, approximately 137 tons of pesticide-contaminated soil were excavated, transported off site, and incinerated. Post-removal action sampling and analysis verified that all pesticide-contaminated soil containing contaminant concentrations above the preliminary remediation goals (PRGs) established in the EE/CA had been excavated and removed from the site.

Risk-based PRGs established in the EE/CA were calculated based on procedures set forth in the USEPA's Risk Assessment Guidance for Superfund. PRGs were developed with a target individual cancer risk of less than 1×10^{-6} for carcinogenic contributors and a target hazard quotient of 1.0 for noncarcinogenic contributors.

As a result of the removal action for pesticide-contaminated soil conducted at the site in 1994, it was expected that a No Further Action (NFA) ROD would be issued. A Post-Removal Action Report was prepared in July 1994; however, based on comments from the USEPA, it was determined that the site needed additional sampling to confirm the completeness of the removal action. Therefore, an RI was conducted at this site in 1997 and 1998 in which surface and subsurface soil and groundwater samples were collected to further characterize site conditions and to determine the presence of other burial areas. Additionally, samples were collected at the ancillary IRP sites that are located within 220 feet of the Pesticide Burial Area.

2.2.3 Enforcement Actions

No enforcement actions have been taken at Site 1. The Navy has owned this property since 1943 and is identified as the responsible party.

2.3 COMMUNITY PARTICIPATION

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from August 6, 1999 through September 18, 1999 for the proposed remedial action described in the Remedial Investigation/Feasibility Study and the Proposed Plan for remedial action at Site 1.

These documents were available to the public in the Administrative Record and information repositories maintained at the John Porter Memorial Library, Stafford, Virginia; the Chinn Park Regional Library, Prince William, Virginia; and the Marine Corps Research Center, Quantico, Virginia. Public notice was provided in the *Potomac News* and the *Free Lance-Star* newspapers on August 5, 1999 and in the *Quantico Sentry* newspaper on August 6, 1999. A public meeting was held at the Quantico Crossroads

Inn on Tuesday, August 17, 1999. No written comments were received during the comment period, and no comments were provided during the public meeting.

2.4 SCOPE AND ROLE OF RESPONSE ACTION FOR SITE 1

The remedial actions identified in the ROD address contamination associated with Site 1 as identified in the RI Report, EE/CA Report, and the Removal Action Report. The selected remedy is that no further action be taken for soil at Site 1. The groundwater will be sampled to confirm that no unacceptable current/future risks are posed by exposures to pesticides in groundwater at the operable unit. Because of a single detection of dieldrin from a temporary well (PBATW003) in October 1997, a temporary monitoring well will be installed downgradient of PBATW003 and the groundwater sampled for this pesticide. The result of the analysis will be compared to the USEPA Region III Risk-Based Screening Level for dieldrin in Residential Tap Water (4.2 mg/L). If the analytical result of the groundwater sampling is less than the respective screening level, the site will close with No Further Action. If the analytical result is determined to be higher than the screening level, a second round of sampling will be conducted and the Navy and regulators will re-evaluate the site.

2.5 SUMMARY OF SITE 1 CHARACTERISTICS

2.5.1 Site Overview

The Pesticide Burial Area consists of a pit located approximately 250 feet northwest of Building 27007 near the intersection of Russell Road and MCB-1. The site is situated on a slope at the edge of a wooded area and adjacent to a parking lot (Figure 2-4). The size of the pesticide burial pit, which received pesticides from the Pest Control Shop (Building 668) in 1974, was reportedly 16 feet in diameter and 8 feet deep.

Several ancillary IRP sites are located adjacent to the Pesticide Burial Area and were evaluated with the Pesticide Burial Area. These sites include the Building 2427 Burn Area (L-17), Building 2427 Disposal Area (L-18), Building 27135 Drum Disposal Area (M-29), and an unnamed ancillary IRP site. Due to these sites being located within 220 feet of the Pesticide Burial Area, they were evaluated in the Site 1 Rl report. L-17, used for open burning, is located approximately 50 feet east of the Pesticide Burial Area and northwest of Building 27007. L-17 is approximately 80 feet long and 20 feet wide. L-18 is located in the woods approximately 80 to 100 feet west of the Pesticide Burial Area and includes an area of more than 2,000 square feet where wastes were placed haphazardly in the vegetation. M-29, located in the southern corner of the parking lot for Building 27007, covers an area of approximately 5 feet by 3 feet where a drum of fuel had previously been found. In addition, a fourth area consisting of miscellaneous debris and drums scattered on the ground surface was identified by the Quantico Project Management

Team during a site visit in July 1997. This area is located 220 feet south of the Pesticide Burial Area and is identified in Figure 2-4 as the “unnamed ancillary IRP site.”

Site 1 is located just east of the Fall Line in the Coastal Plain Physiographic Province. Site topography in the vicinity of the Pesticide Burial Area slopes in a southerly direction. The site is located within the Aquia Creek watershed. Surface water runoff in the vicinity of Site 1 flows in the southwest direction into a heavily vegetated area and is typically absorbed by the topsoil. It is unlikely that surface runoff would reach an intermittent stream, which is located approximately 1,000 feet to the southwest. Ponderosa Pond, the nearest surface water body, is located east-southeast of the site and does not receive surface water runoff from the Pesticide Burial Area.

2.5.2 Remedial Investigation

The final RI was completed for Site 1 in 1998 to verify the effectiveness of the 1994 removal action. The objective of the RI was to determine the extent of contamination in both surficial and deeper soils and to verify that activity at the site has not impacted groundwater quality. Field investigation activities, consisting of a high-resolution electromagnetic (HREM) survey, surface/subsurface soil sampling, and the installation and sampling of groundwater monitoring wells, were completed as part of this effort. The RI is summarized below.

2.5.2.1 Description of Contamination

Analytical parameters for the RI sampling were developed on the basis of historical information, which indicated the Pesticide Burial Area was used for a one-time disposal of pesticides, and on the results of previous sampling events (including post-removal action sampling and analysis). PRGs were developed for the removal action based on residential exposure to pesticides, arsenic, and lead.

As part of the RI, two rounds of HREM terrain conductivity surveying were performed to delineate the absence or presence of additional disposal areas in the vicinity of the disposal pit. The results of the HREM surveys identified six areas that required the excavation of test pits to confirm the presence or absence of additional disposal areas.

Following completion of the north side HREM survey, test pits were excavated and a total of seven subsurface soil samples (including one field duplicate) were collected and analyzed for arsenic, lead, and Target Compound List (TCL) pesticides/polychlorinated biphenyls (PCBs). In addition, five samples were analyzed for grain-size distribution to determine soil particle size and components which aid in the determination of how the pesticides will adhere to the soil. The results of these analyses were used to characterize the Pesticide Burial Area and Ancillary IRP Site L-17. The maximum concentrations of

positively detected chemicals of potential concern (COPCs) for these seven subsurface soil samples are shown in Table 2-1. No PCBs were detected in the samples.

Following completion of the south side HREM survey, a single test pit was excavated and one subsurface soil sample (PBATP006) was collected and analyzed for arsenic, lead, and TCL pesticides. The results of this analysis (also shown in Table 2-1) were used to characterize the area identified in July 1997 and located approximately 220 feet south of the Pesticide Burial Area.

At IRP Site L-18, six surface soil samples (including one field duplicate) were collected and analyzed for Target Analyte List (TAL) metals and TCL pesticides/PCBs.

At IRP Site M-29, five surface soil samples were collected and analyzed for TAL metals, total petroleum hydrocarbons (TPH), and TCL pesticides/PCBs. The maximum concentrations of positively detected COPCs for these five surface soil samples are also shown in Table 2-2.

Three surface soil samples were collected south of the site (unnamed ancillary IRP site), where drums were discovered, and analyzed for TAL metals and TCL pesticides/PCBs. The maximum concentrations of positively detected COPCs for these 14 surface soil samples are shown in Table 2-2. Additionally, a sample (PBADS001) was collected from a drum discovered in the wooded area west of the Pesticide Burial Area but did not reveal any pesticides, PCBs, or arsenic above analytical detection limits.

Groundwater sampling was conducted downgradient of the former disposal pit to further characterize subsurface soil and groundwater conditions. Groundwater beneath the site was generally encountered at depths of 75 feet to 80 feet. Temporary well points were installed at four locations. The three existing groundwater-monitoring wells were sampled and analyzed for arsenic, lead, and TCL pesticides/PCBs, and the four temporary wells were sampled and analyzed for arsenic, lead, and TCL pesticides. The maximum concentrations and frequency of occurrence of chemicals that were found in the samples from the permanent and temporary wells are shown in Table 2-3. RI sampling locations are shown in Figure 2-5.

2.5.2.2 Contaminant Migration

The data indicate that no significant migration of chemicals has occurred from the Pesticide Burial Area into the surrounding region. Low concentrations of pesticides (methoxychlor, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT) were detected in surface soil samples throughout the site and in subsurface soil samples south of the pit area but were not detected in groundwater. Dieldrin was detected in one groundwater sample but was not detected in any surface or subsurface soil samples. Pesticides strongly adhere to soil, do not readily leach to groundwater, and are relatively persistent chemicals in the environment. Dieldrin, 4,4'-

TABLE 2-1

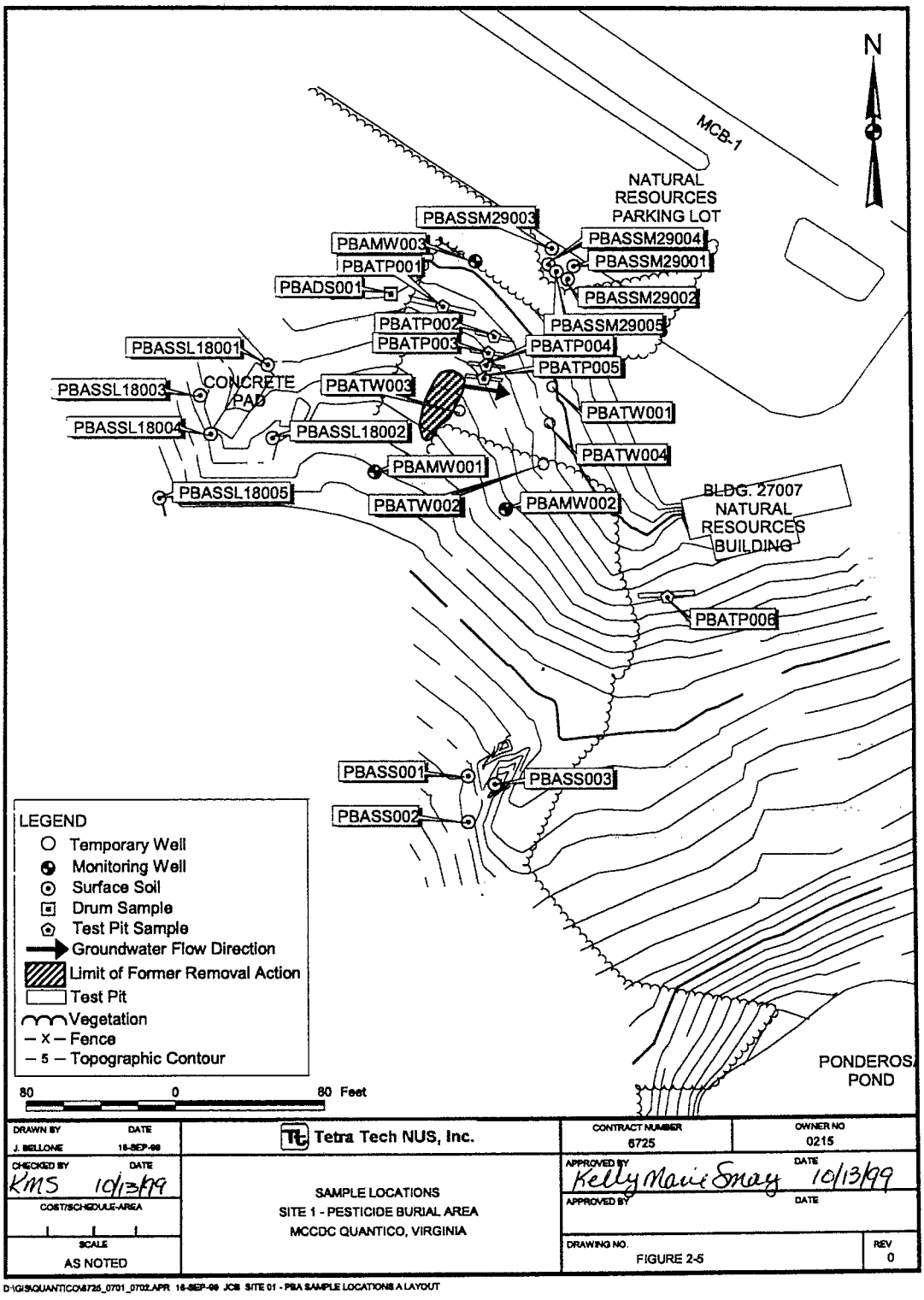
**MAXIMUM DETECTED CONCENTRATIONS
FOR COPCs IN SUBSURFACE SOILS
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA**

	Pesticide Burial Area and IRP Site L-17	Test Pit South of Site	Risk-Based COPC Screening Level		SSL Transfer from Soil to Air [2]	SSL Transfer from Soil to Groundwater [3]
			Residential	Industrial		
Metals (mg/kg)						
Arsenic	0.89 L	3.30 L	0.43 C	3.8 C	750	29
Lead	23.7	15.7 J	400 C	N/A C	NV	NV
Pesticides (mg/kg)						
4, 4'-DDD	ND	0.0094	2700 C	24000 C	NV	16000
4, 4'-DDE	ND	0.820	1900 C	17000 C	NV	54000
4, 4'-DDT	ND	0.220	1900 C	17000 C	NV	32000

Notes:

C Carcinogenic
J Value is considered estimated due to exceedence of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
L Positive result is considered biased low due to exceedence of technical quality control criteria.
N/A Not applicable, chemical was detected in all samples
ND Not detected
NV No value available

1 USEPA Region III Risk-based Concentration Table, October 1, 1998 (Cancer benchmark value = 1E-6, HQ = 0.1).
2 Soil screening level; USEPA Soil Screening Guidance, May 1996.
3 Assumes a dilution attenuation factor (DAF) of 20.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MCB-1
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PBAMW003
PBATP001
PBADS001
PBASSM29004
PBASSM29001
PBASSM29002
PBASSM29005
PBATP002
PBATP003
PBATP004
PBATP005
PBASSL18001
CONCRETE PAD
PBASSL18003
PBATW003
PBATW001
PBASSL18004
PBASSL18002
PBATW004
PBAMW001
PBASSL18005
PBATW002
PBAMW002
BLDG. 27007 NATURAL RESOURCES BUILDING
PBATP006
PBASS001
PBASS003
PBASS002
PONDEROSA POND
LEGEND
Temporary Well
Monitoring Well
Surface Soil
Drum Sample
Test Pit Sample
Groundwater Flow Direction
Limit of Former Removal Action
Test Pit
Vegetation
Fence
Topographic Contour
80 0 80 Feet
DRAWN BY J. BELLONE DATE 16-SEP-99
CHECKED BY KMS DATE 10/13/99
COST/SCHEDULE-AREA
SCALE AS NOTED
Tetra Tech NUS, Inc.
SAMPLE LOCATIONS
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA
CONTRACT NUMBER 6725
OWNER NO 0215
APPROVED BY Kelly Marie Smay DATE 10/13/99
APPROVED BY DATE
DRAWING NO. FIGURE 2-5
REV 0
D:\GIS\QUANTICO\6725_0701_0702.APR 16-SEP-99 JCB SITE 01 - PBA SAMPLE LOCATIONS A LAYOUT

TABLE 2-2

MAXIMUM DETECTED CONCENTRATIONS
FOR COPCs IN SURFACE SOILS
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA

	IRP SITE L-18	IRP SITE M-29	Unnamed Ancillary IRP SITE	Risk-Based COPC Screening Level (1)		SSL Transfer from Soil to Air (2)	SSL Transfer from Soil to Groundwater (2,3)
				Residential	Industrial		
Metals (mg/kg)							
Aluminum	10,100	11,400	4,770	7800 N	2000000 N	NV	NV
Antimony	5.7	6.3	ND	3.1 N	82 N	NV	5
Arsenic	3.5 J	1.6 J	0.96 J	0.43 C	3.8 C	750	29
Barium	32.1	40.2	36.2	550 N	14000 N	690000	1600
Beryllium	0.38	0.39	0.38	16 N	410 N	1300	63
Chromium	25.3	19.0	9.0	23 N	610 N	270	38
Cobalt	4.2	2.4	3.5	470 N	12000 N	NV	NV
Copper	21.2	7.6 K	8.4 K	310 N	8200 N	NV	NV
Iron	23,200	22,400	11,900	2300 N	61000 N	NV	NV
Lead	23.1	74.1 L	21.3	400 C	N/A C	NV	NV
Manganese	119	54.1	118	160 N	400 C	NV	NV
Vanadium	51.0	46.0	25.0	55 N	1400 N	NV	6000
Zinc	33.5	26.4	19.9	2300 N	61000 N	NV	12000
Pesticides (mg/kg)							
4,4'-DDD	0.0046	0.0073 J	0.0028	2700 C	24000 C	NV	16000
4,4'-DDE	0.025	0.025 J	0.780	1900 C	17000 C	NV	54000
4,4'-DDT	0.029	0.0048 J	0.720	1900 C	17000 C	NV	32000
Methoxychlor	ND	0.0067 J	ND	39000 N	1000000 N	NV	160000

TABLE 2-2

MAXIMUM DETECTED CONCENTRATIONS
FOR COPCs IN SURFACE SOILS
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA

	IRP SITE L-18	IRP SITE M-29	Unnamed Ancillary IRP SITE	Risk-Based COPC Screening Level (1)		SSL Transfer from Soil to Air (2)	SSL Transfer from Soil to Groundwater (2,3)
				Residential	Industrial		
Total Petroleum Hydrocarbons (mg/kg)	NA	75.8 B	NA	NV	NV	NV	NV

Notes:

B Positive result is considered to be an artifact of blank contamination, and should not be considered present.
C Carcinogenic
J Value is considered estimated due to exceedence of technical quality control criteria or because result is less than Contract Required Quantitation Limit (CRQL).
K Positive result is considered biased high due to exceedence of technical quality control criteria.
L Positive result is considered biased low due to exceedence of technical quality control criteria.
N Non-Carcinogenic
NA Not analyzed
N/A Not applicable, chemical was detected in all samples
ND Not detected
NV No value available

1 USEPA Region III Risk-Based Concentration Table, October 1, 1998. (Cancer benchmark value = 1E-6, HQ = 0.1).
2 USEPA Soil Screening Guidance, May 1996.
3 Assumes a dilution attenuation factor (DAF) of 20.

TABLE 2-3

OCCURRENCE AND DISTRIBUTION OF CHEMICALS DETECTED IN GROUNDWATER SITE 1 - PESTICIDE BURIAL AREA MCCDC QUANTICO, VIRGINIA

	Permanent Wells		Risk-Based COPC Screening Level [1] Residential Tap Water	USEPA MCL [2]	Virginia Drinking Water Standard [3]
	Frequency of Detection	Maximum Concentration			
Metals (µg/L)					
Arsenic	2/3	2.1	0.045 C	50	50
Lead	3/3	22	NV	15[4]	15
Pesticides (µg/L)					
Dieldrin	0/3	ND	0.0042 C	NV	NV

	Temporary Wells		Risk-Based COPC Screening Level [1] Residential Tap Water	USEPA MCL [2]	Virginia Drinking Water Standard [3]
	Frequency of Detection	Maximum Concentration			
Metals (µg/L)					
Arsenic	0/4	ND	0.045 C	50	50
Lead	1/4	1.0	NV	15[4]	15
Pesticides (µg/L)					
Dieldrin	1/4	0.24	0.0042 C	NV	NV

1 USEPA Region III Risk-Based Concentration Table, October 1, 1998. (Cancer benchmark value = 1E-6, HQ = 0.1)
2 USEPA Drinking Water Regulations and Health Advisories, October, 1996.
3 Virginia Department of Health RVAC 5-590.
4 SDWA Action Level

ND Not detected
C Carcinogenic
NV No value available

TABLE 2-4

COMPARISON OF SURFACE/SUBSURFACE SOIL DATA WITH LITERATURE BACKGROUND VALUES
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA

CAS Number	Chemical	Minimum Detected Concentration	Minimum Qualifier	Maximum Detected Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Literature Background Value (1)
Metals										
7429-90-5	Aluminum	3480		11400		mg/kg	PBASSM290002	13/13	N/A	7000 - 100000
7440-36-0	Antimony	5.3		6.3		mg/kg	PBASSM290002	3/13	4.3-4.7	<1 - 8.8
7440-38-2	Arsenic	0.28		3.5	J	mg/kg	PBASSL180002	18/20	0.25-0.26	0.1 - 73
7440-39-3	Barium	18.1		40.2		mg/kg	PBASSM290003	13/13	N/A	10 - 1500
7440-41-7	Beryllium	0.23		0.39		mg/kg	PBASSM290002	10/13	0.22-0.22	<1 - 7
7440-47-3	Chromium	7.4		25.3		mg/kg	PBASSL180002	13/13	N/A	1 - 1000
7440-48-4	Cobalt	1.2		4.2		mg/kg	PBASSL180004-D	13/13	N/A	0.3 - 70
7440-50-8	Copper	4.6	J	21.2		mg/kg	PBASSL180005	13/13	N/A	<1 - 700
7439-89-6	Iron	8410		23200		mg/kg	PBASSL180002	13/13	N/A	100 - > 100000
7439-92-1	Lead	9.1		74.1		mg/kg	PBASSM290003	20/20	N/A	<10 - 300
7439-96-5	Manganese	10.1		119		mg/kg	PBASSL180004-D	13/13	N/A	<2 - 7000
7440-62-2	Vanadium	17.3		51		mg/kg	PBASSL180005	13/13	N/A	<7 - 300
7440-66-6	Zinc	9.7		33.5		mg/kg	PBASSL180003	13/13	N/A	<5 - 2900

Notes:

J Value is considered estimated due to exceedance of technical quality criteria or because result is less than Contract Required Quantitation Limit (CRQL).

N/A Not Applicable, chemical was detected in all samples.

1 Element Concentrations in Soils and Other Surficial Materials of the Conterminous United Stated, Shacklette and Boerngen, 1984.

DDE, and 4,4'-DDD are transformation by-products of pesticides, and their presence in soil at the Pesticide Burial Area may be due to the degradation of other pesticides.

Since no site-specific background soil samples were collected in the Pesticide Burial Area, it is not known if the metals detected in site soil are site related or related to background conditions. However, metal concentrations were well within literature background levels (Table 2-4), which suggests that the metals detected in the soil are naturally occurring and not site-related. The concentrations of arsenic in surface soil samples are comparable to those in subsurface soil samples. The concentrations of lead in surface soil samples are higher than those in subsurface soil samples. Metals are highly persistent environmental contaminants. The major fate mechanisms for metals are adsorption to the soil matrix and bioaccumulation. Because metals are frequently incorporated into the soil matrix and remain bound to particulate matter, they tend to migrate from the source areas via bulk movement processes (erosion).

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The Pesticide Burial Area is located approximately 250 feet northwest of Building 27007. It is covered in turf grass and is a part of the lawn surrounding Building 27007. The lawn forms a cove at the Pesticide Burial Area that is about 80 feet wide and 120 feet long. The cove of grass is bounded on the north by a line of evergreen trees that separates the grassed area from the parking lot for Building 27007. The south and west sides of the cove are formed by woods. Spacing between the trees is typically wide enough to support dense vegetation.

Several ancillary IRP sites are located adjacent to the Pesticide Burial Area. These sites include Building 2427 Burn Area (L-17), Building 2427 Disposal Area (L-18), Building 27135 Drum Disposal Area (M-29), and an area where drums were discovered south of the site ("unnamed ancillary IRP site"). L-17 was used for open burning and is located 50 feet east of the Pesticide Burial Area. L-18 is located about 100 feet west of the Pesticide Burial Area in the woods. M-29 is located in the southern corner of the parking lot for Building 27007, about 50 feet northeast of the Pesticide Burial Area. At the unnamed ancillary IRP site, drums were found in the woods approximately 220 feet southeast of the Pesticide Burial Area and southwest of Building 27007.

Site 1 is currently a military land use area and is anticipated to either remain a military land use area in the future or become an industrial or commercial land use area. The mission of the base is currently expanding, and future potential for base closure and conversion to residential land use is considered to be minimal. Groundwater in the aquifer beneath Site 1 is not a current source of drinking water.

2.7 SUMMARY OF SITE 1 RISKS

The ecological and human health risks associated with exposure to contaminated media at Site 1 were evaluated in the RI Report. The residential use scenario was evaluated for completeness, although the site is anticipated to remain in industrial use.

2.7.1 Environmental Evaluation

To assess protection of the environment, a screening level ecological risk assessment was performed. Site 1 is a small ecologically-disturbed area on the edge of a wooded area. Several ancillary areas, formerly used for disposal, storage, and open burning, are located in close proximity to the site and are in the same habitat. There is a potential for ecological receptors to be exposed to contaminants in surface soil and also in dietary components at these sites. Maximum detected concentrations of contaminants in surface soil exceeded EPA Region III ecological screening criteria for pesticides and inorganics (metals) in surface soils which indicates the potential for ecological risk.

It is unlikely that the pesticides and inorganics detected at Site 1 represent a significant ecological risk beyond the risk present from existing background concentrations. The source of the hazardous substances detected at a site can be considered when determining the risk presented to ecological receptors for purposes of developing a ROD for the site. Pesticide concentrations are detected at levels indicative of past applications rather than disposal activities. Furthermore, inorganic concentrations are generally present at background concentrations and are not generally bioavailable under usual soil conditions; however, bioavailability has not been determined specifically for the site.

2.7.2 Human Health Risks

Exposure Pathways and Potential Receptors

Potential receptors for the Pesticide Burial Area include current/future base personnel, current/future adolescent and adult trespassers, future construction workers, and hypothetical future residents. Current/future off-site or base recreational users were not considered as potential receptors because there are no streams for swimming, wading, or fishing in or immediately downgradient of the Pesticide Burial Area. COPCs were identified based on exceedances of residential screening criteria (Table 2-5). Therefore, only exposures by current/future adolescent and adult trespassers and hypothetical future residents were quantitatively evaluated in the risk assessment. Potential exposure by current/future base personnel and future construction workers were not quantitatively evaluated since there were no exceedances of the nonresidential screening criteria.

Adolescent and adult trespassers were assumed to be exposed to shallow soil only. Exposures to surface water and sediments and ingestion of fish by adolescent and adult trespassers were not considered since there are no streams for swimming, wading, or fishing at the Pesticide Burial Area. Potential exposure pathways for adolescent and adult trespassers include incidental ingestion of surface soil and dermal contact with surface soil.

Hypothetical future residents were evaluated in the risk assessment for purposes of completeness only. Given that the current land use for the Pesticide Burial Area is military and future land use is expected to be military, industrial, or commercial, it is unlikely that this area would be developed for residential use. It was assumed that hypothetical future onsite residents might be exposed to surface and subsurface soil. It was also assumed that groundwater would be used as a potable water source for the hypothetical future resident. Exposures to surface water and sediments and ingestion of fish by hypothetical future residents were not considered since there are no streams for swimming, wading, or fishing at the Pesticide Burial Area. Potential exposure pathways considered for hypothetical future residents included incidental ingestion of soil, dermal contact with soil, ingestion of groundwater, and dermal contact with groundwater. Potential exposures to fugitive dust and volatile organic compound (VOC) emissions from soil at the Pesticide Burial Area were considered to be minimal because chemicals were not detected in surface and subsurface soil at concentrations exceeding the USEPA soil screening levels (SSLs) for transfer from soil to air.

Exposure Assessment

The COPCs that were evaluated and their exposure-point concentrations are presented in Table 2-5. Exposure-point concentrations are used to determine potential human health risks.

Toxicity Assessment

Cancer potency factors (CPFs) have been developed by USEPA's Carcinogen Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals.

CPFs, which are expressed as $(mg/kg/day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in milligrams per kilograms per day (mg/kg/day), to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPFs. Use of this approach makes underestimation of the actual cancer risk highly unlikely. CPFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

TABLE 2-5

COPCs AND EXPOSURE-POINT CONCENTRATIONS [1]
SITE 1 - PESTICIDE BURIAL AREA
MCCDC QUANTICO, VIRGINIA

	Organics		Inorganics	
	Chemical	**Exposure-Point Concentration[1]**	**Chemical**	**Exposure-Point Concentration[1]**
Surface Soil (mg/kg)				
Current and Future Base Worker and Trespasser, and Future Construction Worker and Residential Scenarios	None	NA	Aluminum Antimony Arsenic Chromium Iron	8,370 3.64 1.61 15.0 17,300
Surface/Subsurface Soil (mg/kg)				
Current and Future Base Worker and Trespasser, and Future Construction Worker and Residential Scenarios	None	NA	Aluminum Antimony Arsenic Chromium Iron	8,370 3.64 1.93 15.0 17,300
Groundwater (µg/L)				
Current and Future Base Worker and Trespasser, and Future Construction Worker and Residential Scenarios	Dieldrin	0.24 (RME) 0.043 (CTE)	Arsenic Lead	2.1 (RME) 0.886 (CTE) 4.84

1 Maximum concentrations are used as exposure-point concentrations for groundwater for the Reasonable Maximum Exposure (RME), and average concentrations are used for the Central Tendency Exposure (CTE) case because the groundwater database contains less than 10 samples; 95% Upper Confidence Limits (UCLs) are used as the exposure-point concentrations for surface soils and subsurface soils.

NA Not Applicable - Detected concentrations did not exceed screening criteria.

Reference doses (RfDs) have been developed by USEPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals, that are likely to be without an appreciable risk of adverse effects during a lifetime. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared with the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (i.e., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Risk Characterization

Excess lifetime cancer risks are determined by multiplying the intake level with the CPF. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime, under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's RfD). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Trespasser. The cumulative noncancer HIs for adolescent and adult trespassers exposed to surface soil are less than 1, which indicates that no significant hazards are associated with soils at Site 1.

The cumulative ingestion and dermal contact cancer risk is 2.0×10^{-7}, under the RME scenario, which is less than the USEPA's target risk range of 1×10^{-4} to 1×10^{-6}.

Future Resident. The cumulative HI for exposures to soil and groundwater for a hypothetical child resident at Site 1 is 2.6 for the RME. When an HI exceeds unity, target organ effects from individual COPCs contributing to the risk are considered. The HIs for the target organs are 1.0 for the liver, 0.56 for the skin, 0.22 for blood, 0.14 for the central nervous system, and 0.64 for the kidney. Since the HI for the individual target organs are less than or equal to 1, no adverse health effects are anticipated from exposure by a hypothetical child resident to soil and groundwater at Site 1.

The HIs for the hypothetical adult resident exposed to surface soil, subsurface soil, and groundwater is 1.4 which slightly exceeds the acceptable level of 1.0. The HIs for the individual target organs are 0.72 for the liver, 0.21 for the skin, 0.08 for the blood, 0.03 for the central nervous system, and 0.36 for the kidney. Since the HI for the individual target organs are less than 1.0, no adverse health effects are anticipated from exposure by an adult resident to soil and groundwater at Site 1.

All estimated cancer risks for child and adult residents exposed to surface and subsurface soil were within USEPA's target risk range of 10^{-4} to 10^{-6}. Cancer risks for a hypothetical child resident exposed to surface and subsurface soil were 4.1×10^{-6} for the RME scenario and 4.0×10^{-7} for the CTE scenario. Cancer risks for a hypothetical adult resident exposed to surface and subsurface soil were 3.6×10^{-6} for the RME scenario and 2.2×10^{-7} for the CTE scenario. The total cancer risk for a combined hypothetical on-site child and adult resident exposed to surface and subsurface soil is 7.8×10^{-6} for the RME scenario and 6.1×10^{-7} for the CTE scenario.

Cancer risks for a hypothetical child resident exposed to groundwater are within USEPA's target risk range of 10^{-4} to 10^{-6}. Cancer risks for a hypothetical child resident exposed to groundwater are 6.6×10^{-5} for the RME scenario and 3.4×10^{-6} for the CTE scenario. The cancer risk for a hypothetical adult resident exposed to groundwater is 1.3×10^{-4} for the RME scenario, which slightly exceeds USEPA target risk range. The cancer risk for a hypothetical adult resident exposed to groundwater under the CTE scenario is 4.5×10^{-6}, which is within USEPA's target risk range. The total cancer risk for a hypothetical child and adult resident exposed to groundwater is 2.0×10^{-4} for the RME scenario which exceeds USEPA's target risk range and 7.8×10^{-6} for the CTE scenario, which is within USEPA's target risk range. Dieldrin is the primary contributor to the estimated risk. However, Dieldrin was detected in only one groundwater sample and its detection is believed to be the result of the temporary well installation and not indicative of site-related contamination.

Lead and Other Metals. The maximum detected concentration of lead in groundwater exceeds the Federal and state action level of 15 µg/L. All other lead concentrations are less than the action level. The Integrated Exposure Uptake Biokinetic (IEUBK) Model was used to evaluate exposures to lead in soil and groundwater by hypothetical resident children. USEPA's IEUBK Model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, dirt, dust, and soil exposure. The results of this modeling effort indicated that no adverse effects are anticipated for children exposed to lead in soil and groundwater at the Pesticide Burial Area.

Although no site-specific background samples were collected for the Pesticide Burial Area, concentrations of metals in site soil are typical for the area, based on the literature background values (Table 2-4), suggesting that metals detected in site soil are naturally occurring.

2.7.3 Summary, Conclusions, and Recommendations

The following items summarize the major findings for Site 1 - Pesticide Burial Area, based on the post removal action database.

- Pesticides were detected at IRP Sites L-18 and M-29 in soil samples collected beneath the drums to the south of the site. Pesticides are not readily leachable to the groundwater and were not detected in the groundwater samples at significant concentrations, which indicates that no significant migration of the chemicals from the Pesticide Burial Area has occurred. Dieldrin, the only pesticide detected in groundwater, was not detected in soil samples. Arsenic and lead were also detected in the soil. Concentrations of these metals were higher in the surface soil than the subsurface soil and they were detected infrequently in groundwater. Metals are relatively immobile and readily adsorb to the soil matrix and bioaccumulate.

- In the ecological risk assessment, 4,4'-DDE and 4,4'-DDT were detected in all 13 surface soil samples, 4,4'-DDD was detected in 11 of 13 samples; and methoxychlor was detected in one sample. 4,4'-DDE and 4,4'-DDT were COPCs, as were aluminum, antimony, beryllium, copper, chromium, iron, lead, vanadium, and zinc. Risk management considerations reveal that the mean 4,4'-DDE and 4,4'-DDT concentrations are within the range of available PRGs and that the fairly low concentrations seen may be due to the base-wide use of pesticides in the past. Risk levels for metals are low when compared to additional guidelines, and some are also similar to background concentrations.

- The human health risk assessment considered potential exposures by current/future base personnel, current/future adolescent and adult trespassers, future construction workers, and hypothetical future residents. Incremental cancer risks for all receptors exposed to soil were within USEPA's target risk range of 10^{-4} to 10^{-6}. The estimated HI for a hypothetical future child resident exposed to soil under the RME scenario exceeded the acceptable level of 1.0 while the estimated hazard indices under the CTE scenario were within acceptable levels. Iron, which is an essential nutrient, was the main contributor to the HI. Site-specific background samples were not collected for iron, but concentrations of iron were within literature background levels.

- The cancer risk for a hypothetical future adult resident exposed to groundwater under the RME scenario exceeded the upper bound of EPA's target risk range (10^{-4}) while cancer risks under the CTE scenario were within USEPA's target risk range. Cancer risks for a hypothetical future child resident were within or less than USEPA's target risk range. Dieldrin was the main contributor to the cancer risk for the hypothetical future adult resident. Dieldrin was detected in only one groundwater

sample, and its detection is likely to be the result of the temporary well installation and not indicative of site-related contamination.

The Pesticide Burial Area requires no further action with further characterization of the groundwater based on the following information:

1. A removal action was performed in the suspected area of the Site 1 - Pesticide Burial Area pit, and confirmation sampling concluded that the site soils do not present an unacceptable risk to residential receptors for current or future land use.

2. Relatively low concentrations of pesticides and metals were detected in soil. These chemicals were detected infrequently in the groundwater. This result suggests that the compounds are not migrating from the surface soil.

3. No COPCs were identified during the baseline human health risk assessment for receptors under a current industrial land use scenario. Although there are no plans for residential land use of this site, a risk characterization for a potential residential scenario is provided for completeness. Although dieldrin detected in groundwater was the main contributor to human health risk, it is anticipated that the single detection was a result of a temporary well installation and is not indicative of a contaminant plume. To retest the groundwater, a temporary monitoring well will be installed downgradient of PBATW003 and the groundwater sampled for this pesticide. The result of the analysis will be compared to the USEPA Region III Risk-Based Screening Level for Residential Tap Water.

4. From a realistic perspective, the potential for this site to impact ecological receptors is low. Although the ecological risk assessment concluded that some metals and pesticides were above screening levels, risk levels associated with these COPCs are comparable to regional background levels.

2.8 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy is the same alternative identified as the preferred alternative in the Proposed Plan for remedial action which was presented to the public at the Public Meeting held August 17, 1999.

There were no changes to the preferred remedial action alternative in the Proposed Plan.

3.0 RESPONSIVENESS SUMMARY

3.1 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy-Marine Corps and MCCDC Quantico have had a comprehensive public involvement program for several years. Beginning in 1994, a Technical Review Committee (TRC) has met approximately once every 2 years to discuss issues related to investigative activities at MCCDC Quantico. The TRC is composed mostly of Navy and Marine Corps, EPA, and Commonwealth of Virginia personnel; however, a few private citizens attend the meetings on occasion.

MCCDC has taken several public surveys involving those people living on the base or nearby to determine whether or not there is a need for a Restoration Advisory Board (RAB). In every case the surveys indicated that the formation of a RAB was not warranted.

Community relations activities for the final selected remedy include:

- The documents concerning the investigation and analysis at Site 1, as well as a copy of the Proposed Plan, were placed in the information repository at the Marine Corps Research Center, the John Porter Memorial Library, and the Chinn Park Regional Library.

- Newspaper announcements on the availability of the documents and the public comment period/meeting date were placed in the *Potomac News* and the *Free Lance-Star* on August 5, 1999 and the *Quantico Sentry* newspaper on August 6, 1999.

- The Navy established a 45-day public comment period starting August 6, 1999 and ending September 18, 1999 to present the Proposed Plan for Remedial Action. No written comments were received during the 45-day public comment period.

- A Public Meeting was held August 17, 1999 to answer any questions concerning the Proposed Plan for Site 1. Approximately 10 people, including Federal and state local government representatives, attended the meeting.

3.2 STAKEHOLDER ISSUES AND LEAD AGENCY RESPONSES

No written comments, concerns, or questions were received by the Navy, USEPA, or the Commonwealth of Virginia during the public comment period from August 6, 1999 to September 18, 1999. A public meeting was held on August 17, 1999 to present the Proposed Plan for Site 1 soils and groundwater and

to answer any questions on the Proposed Plan and on the documents in the information repositories. A period was set aside for formal questions to be recorded by the court reporter. However, no questions were asked and no comments were offered.

3.3 TECHNICAL AND LEGAL ISSUES

There are no technical or legal issues concerning the selected remedial action at this site.

APPENDIX A

TOXICITY PROFILES

TOXICITY PROFILES - QUANTICO, SITE 1

ALUMINUM

Aluminum is not generally regarded as an industrial poison. Inhalation of finely divided powder has been reported as a cause of pulmonary fibrosis. Aluminum in aerosols has been implicated in Alzheimer's disease. As with other metals, the powder and dust are the most dangerous forms. Most hazardous exposures to aluminum occur in refining and smelting processes. Aluminum dust is a respiratory and eye irritant. The EPA has published an oral RfD of 1.00 mg/kg/day (IRIS) and an inhalation reference dose of 0.001 mg/kg/day (HEAST, 1997) for aluminum.

ANTIMONY

Ingested antimony is absorbed slowly and incompletely from the gastrointestinal (GI) tract. Within a few days of acute exposure, highest tissue concentrations are found in the liver, kidney, and thyroid. Organs of storage include skin, bone, and teeth. Highest concentrations in deceased smelter workers (inhalation exposure) occurred in the lungs and skeleton.

Acute intoxication from ingestion of large doses of antimony induces GI disturbances, dehydration, and cardiac effects in humans. Chronic effects from occupational exposure include irritation of the respiratory tract, pneumoconiosis, pustular eruptions of the skin called "antimony spots," allergic contact dermatitis, and cardiac effects, including abnormalities of the electrocardiograph (ECG) and myocardial changes. Cardiac effects were also observed in rats and rabbits exposed by inhalation for six weeks and in animals (dogs, and possibly other species) treated by intravenous injection.

Chronic oral exposure resulted in reduced longevity in both species and in reduced mean heart weight in the rats. The EPA verified an RfD of 0.0004 mg/kg/day for chronic oral exposure to antimony from the LOAEL of 5 ppm potassium antimony tartrate (0.35 mg antimony/kg body weight-day) in the lifetime study in rats. The heart is considered a likely target organ for chronic oral exposure of humans.

Antimony is classified in EPA cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans).

ARSENIC

The toxicity of inorganic arsenic (As) depends on its valence state (-3, +3, or +5), and also on the physical and chemical properties of the compound in which it occurs. Trivalent (As+3) compounds are generally more toxic than pentavalent (As+5) compounds, and the more water soluble compounds are usually more

toxic and more likely to have systemic effects than the less soluble compounds, which are more likely to cause chronic pulmonary effects if inhaled.

The Reference Dose for chronic oral exposures, 0.0003 mg/kg/day, is based on a NOAEL of 0.0008 mg/kg/day and a LOAEL of 0.014 mg/kg/day for hyperpigmentation, keratosis, and possible vascular complications in a human population consuming arsenic-contaminated drinking water. Because of uncertainties in the data, U.S. EPA states that "strong scientific arguments can be made for various values within a factor of 2 or 3 of the currently recommended RfD value." The subchronic Reference Dose is the same as the chronic RfD, 0.0003 mg/kg/day.

Epidemiological studies have revealed an association between arsenic concentrations in drinking water and increased incidences of skin cancers (including squamous cell carcinomas and multiple basal cell Carcinomas), as well as cancers of the liver, bladder, respiratory and gastrointestinal tracts. Occupational exposure studies have shown a clear correlation between exposure to arsenic and lung cancer mortality. U.S. EPA has placed inorganic arsenic in weight-of-evidence group A, human carcinogen.

CHROMIUM

In nature, chromium (III) predominates over chromium (VI). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Chromium (III) is considered a nutritionally essential trace element and is considerably less toxic than chromium (VI). Acute oral exposure of humans to high doses of chromium (VI) induced neurological effects, GI hemorrhage and fluid loss, and kidney and liver effects. An NOAEL of 2.5 mg chromium (VI) /kg/day in a one-year drinking water study in rats and an uncertainty factor of 300 was the basis of a verified RfD of 0.003 mg/kg/day for chronic oral exposure. An NOAEL (No effects were observed in rats consuming 5% chromium (III)/kg/day in the diet for over two years) of 1,468 mg/kg-day for chromium (III) and an uncertainty factor of 100 was the basis of the RfD of 1.5 mg/kg/day for chronic oral exposure.

Occupational (inhalation and dermal) exposure to chromium (III) compounds induced dermatitis. Similar exposure to chromium (VI) induced ulcerative and allergic contact dermatitis, irritation of the upper respiratory tract including ulceration of the mucosa and perforation of the nasal septum, and possibly kidney effects.

A target organ was not identified for chromium (III). The kidney appears to be the principal target organ for repeated oral dosing with chromium (VI). Additional target organs for dermal and inhalation exposure include the skin and respiratory tract.

DIELDRIN

Dieldrin is an insecticide which from 1950-1970 was a popular pesticide for crops like corn and cotton. Because of concerns about damage to the environment and the potential harm to human health, EPA banned all uses of dieldrin in 1974 except to control termites. In 1987, EPA banned all uses. Exposure to dieldrin happens mostly from eating contaminated foods, such as root crops, fish, or seafood. Dieldrin builds up in the body after years of exposure and can damage the nervous system.

Exposure to dieldrin mainly affect the central nervous system. Ingestion of high levels of dieldrin result in convulsions and death. These levels are many thousands of times higher than the average exposure. Ingesting moderate levels of dieldrin over a longer period may also cause convulsions. We don't know the effects of exposure to low levels of dieldrin over a long time. Some workers who made or applied dieldrin had nervous system effects with excitation leading to convulsions. Lesser effects in some workers included headaches, dizziness, vomiting, irritability, and uncontrolled muscle movements. Workers removed from the source of exposure rapidly recovered from most of these effects. The EPA had established an oral RfD of 5E-5 mg/kg-day for dieldrin based on liver lesions in rats from a 2-year study.

There is no direct evidence that dieldrin causes cancer in humans. Studies on workers generally show no increase in cancer or deaths due to cancer. Mice given high amounts of dieldrin, however, did develop liver cancers. Dieldrin has been classified as a probable human carcinogen (B2) by the EPA because it caused tumors in rodents when administered orally.

IRON

In humans and other animals, iron levels in the body are regulated primarily through changes in the amount of iron absorbed by the gastrointestinal mucosa. The absorption of dietary iron is influenced by body stores, by the amount and chemical nature of iron in ingested food, and by a variety of dietary factors that increase or decrease the availability of iron for absorption. However, excessive accumulation of iron in the body resulting from chronic ingestion of high levels of iron cannot be presented by intestinal regulation of absorption, nor do humans have a mechanism to increase excretion of absorbed iron in response to elevated body levels.

There are no toxicity values available for iron in EPA's Integrated Risk Information System (IRIS) database or Health Effects Assessment Summary Tables (HEAST). Iron is an essential nutrient and deriving a toxicity value for such chemicals poses a special problem in that the dose adversity curve is "U-Shaped". Thus, the toxicity value must be protective against deficiency as well as toxicity. EPA's National Center for Environmental Assessment (NCEA) has derived a provisional reference dose (RfD) for iron using data obtained from the second National Health and Nutrition Examination Survey

(NHANES II) database. The NHANES II data indicates that the average intakes of iron ranged from 0.15 to 0.27 mg/kg/day. These levels are sufficient to protect against iron deficiency and insufficient to cause the toxic effects of iron overload. Using the intake level of 0.27 mg/kg/day and dividing by an uncertainty factor of 1, NCEA derived a provisional RfD of 0.3 mg/kg/day for iron.

The above RfD for iron is based on the RDA for adult human nutrition. Children and adolescents require more iron in their diets than adults do, consequently, using and RfD based on the adult RDA for iron to evaluate exposures to children results in an overestimation of the risks for children. U.S. EPA Region III recommends a value of 1.1 mg/kg/day be used as the RfD to evaluated risks for exposures by children. This value is based on the RDA of 0.36 to 1.11 mg/kg/day for children ages 6 months to 10 years.

LEAD

Studies in humans indicate that an average of 10 percent of ingested lead is absorbed, but estimates as high as 40 percent were obtained in some individuals. Nutritional factors have a profound effect on GI absorption efficiency. Children absorb ingested lead more efficiently than adults; absorption efficiencies up to 53 percent were recorded for children three months to eight years of age. Similar results were obtained for laboratory animals; absorption efficiencies of 5 to 10 percent were obtained for adults and > 50 percent were obtained for young animals. The deposition rate of inhaled lead averages approximately 30 to 50 percent, depending on particle size, with as much as 60 percent deposition of very small particles (0.03 mm) near highways. All lead deposited in the lungs is eventually absorbed. About 90 percent of the body burden of lead is located in the skeleton. Neonatal blood concentrations are about 85 percent of maternal concentrations.

Noncancer toxicity of lead

The noncancer toxicity of lead to humans has been well characterized through decades of medical observation and scientific research. The principal effects of acute oral exposure are colic with diffuse paroxysmal abdominal pain (probably due to vagal irritation), anemia, and, in severe cases, acute encephalopathy, particularly in children. The primary effects of long-term exposure are neurological and hematological. Limited occupational data indicate that long-term exposure to lead may induce kidney damage. The principal target organs of lead toxicity are the erythrocyte and the nervous system. Some of the effects on the blood, particularly changes in levels of certain blood enzymes, and subtle neurobehavioral changes in children, appear to occur at levels so low as to be considered nonthreshold effects.

The USEPA determined that it is inappropriate to derive an RfD for oral exposure to lead for several reasons. First, the use of an RfD assumes that a threshold for toxicity exists, below which adverse effects

are not expected to occur; however, the most sensitive effects of lead exposure, impaired neurobehavioral development in children and altered blood enzyme levels associated with anemia, may occur at blood lead concentrations so low as to be considered practically nonthreshold in nature. Second, RfD values are specific for the route of exposure for which they are derived. Lead, however, is ubiquitous, so that exposure occurs from virtually all media and by all pathways simultaneously, making it practically impossible to quantify the contribution to blood lead from any one route of exposure. Finally, the dose-response relationships common to many toxicants, and upon which derivation of an RfD is based, do not hold true for lead. This is because the fate of lead within the body depends, in part, on the amount and rate of previous exposures, the age of the recipient, and the rate of exposure. There is, however, a reasonably good correlation between blood lead concentration and effect. Therefore, blood lead concentration is the appropriate parameter on which to base the regulation of lead.

USEPA (1997) presented no inhalation RfC for lead, but referred to the national ambient air quality standard (NAAQS) for lead, which could be used in lieu of an inhalation RfC. The NAAQSs are based solely on human health considerations and are designed to protect the most sensitive subgroup of the human population. The NAAQS for lead is 1.5 mg/m3, averaged quarterly.

Carcinogenicity of lead

USEPA classifies lead in cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate evidence of cancer in humans and sufficient animal evidence. The human data consist of several epidemiologic occupational studies that yielded confusing results. All of the studies lacked quantitative exposure data and failed to control for smoking and concomitant exposure to other possibly carcinogenic metals. Rat and mouse bioassays showed statistically significant increases in renal tumors following dietary and subcutaneous exposure to several soluble lead salts. The USEPA has declined to estimate risk for oral exposure to lead because many factors (e.g., age, general health, nutritional status, existing body burden and duration of exposure) influence the bioavailability of ingested lead, introducing a great deal of uncertainty into any estimate of risk.

USEPA guidance recommends using 400 mg/kg as a screening level for lead in soil for residential scenarios at CERCLA sites and at RCRA Corrective Action sites. Residential areas with soil lead below 400 mg/kg generally require no further action. However, in some special situations, further study is warranted below the screening level (e.g., wetlands, agricultural areas).